Developing a Dynamic Plant Height Model to Manage Rice Lodging Risk for Decision-Making in Paddy System

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ABSTRACT

Rice, a critical global food crop, is susceptible to lodging, especially during the late growth stages due to panicle initiation. This lodging leads to decreased plant height and reduced crop yield. Over a four-year period, we examined the impact of two water irrigation methods and four fertilizer application frequencies on lodging under varying cultivation conditions. We collected plant height data and supplemented these with aerial images to analyze the effects of nitrogen fertilizer on lodging. The images and variance analysis indicated that fields with high nitrogen levels were more prone to lodging. Specifically, plant height at the booting stage showed a strong positive correlation with lodging occurrence ($r = 0.67$) and a negative correlation with yield ($r = -0.46$). Notably, when plant height exceeded 70.7 cm with continued nitrogen application, the growth curve predicted increased lodging risk. Additionally, our results indicated that increased rainfall and strong gusts in the later stages of growth further elevated this risk. These findings provide predictive insights useful for intelligent production systems and lodging risk management. They also serve as a foundation for developing cultivation management strategies and response policies tailored to each growth phase.

Keywords: Rice, nitrogen fertilizer, plant height, lodging, taste quality, UAV